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A design practice for interactive- direct teaching based on constructivist learning (IDTBCL): boiling and evaporation

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Abstract

In Interactive Direct Teaching Based on Constructivist Learning (IDTBCL), learning is evaluated as an oriented change or a mental passing from comprehending to understanding. The mental transition which will be actualized through the teaching activities in lesson practice of this approach includes creating the awareness of students related to the current concepts, creating a broad mental space including multiple conceptual parts, providing the adaptation of the new information to the previous knowledge through constant contextual communication, and harmonization. Misconceptions on Boiling and Evaporation are frequently encountered. In this study, fifty students studying at a state high school in province of Erzurum were chosen as the sample group. Half of the participants were determined as the control group and the rest as the experimental group. The implementation was performed as a quasi-experimental research design practice in the form of a control group pre-test post-test. A conceptual success test was administrated to the groups before the implementations as the pre-test. According to the results of pre-test, no significant difference between the groups was observed in terms of the conceptual success. After the teaching was accomplished by the same teacher in both groups, a significant difference was determined between the groups according to the post-test results and this difference was associated with the teacher's sense of learning. The significant positive change determined in the experimental group can be attributed to the positive attitude of the student towards this approach.

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Keywords: Constructivist learning; direct teaching; Interactive direct teaching; Interactive Direct Teaching Based on Constructivist Learning (IDTBCL)

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1. Introduction

Learning is a process which continues constantly without a specific end point. Human beings learn anything as they live (Meirink *et al*., 2009) and acquire attitude, skill, knowledge and value as a result of their interaction with their surroundings. These acquisitions form the basis of learning. Consequently, changes in thoughts, emotions, and behaviors are observed in people. There are various theories on how these changes occur. These theories are behavioral, cognitive, and affective theories. Recently, several approaches have been established to provide a strong learning environment. The most important requirement for all of these approaches is to find firstly, the teacher who is well-trained and have the desired characteristics (Germann *et al.,* 1996; Schelfhout *et al.*, 2006; Tynjala, 1999; Rasul, Bukhsh & Batool, 2011; Özbay *et al.*, 2012; Tulbure, 2012). Constructivist approach is the leading one among all these theories. With the rapid developments in all fields, information and technology have become an integral part of every area in our lives in our age instead of individuals who have information that is memorized and not related to each other. It is necessary that everybody is able to see the relationship between information and analyzing, to synthesize new information and to use the new information in solving the problems (Baeten, Struyven & Dochy, 2013; Canpolat *et al.,* 2009; Nie & Lau, 2009; Osman *et al.,* 2009; Taylor et al., 1997). In the constructivist approach, learning is both subjective and social (Ernest*,* 1998). Subjectivity is individual's internalization of what s/he has learnt with symbols, models, concepts, and graphics. Learning is socially developed by means of exchanging information and interaction with others through cooperation (Özden, 2010). An important point for active learning is the role held by the teacher. In active learning model, the teacher organizes the learning environment in advance, determines what will be performed during the course, and creates the materials to be used. In addition, the lesson is more joyful, fast, amusing, and attention-grabbing. The most important characteristics of active learning is to integrate the student with the real life, actualize the permanent learning, and provide meaningful learning (Kalem & Fer, 2003).Meaningful learning means learning ideas, concepts, and principles through associating the new information with the one already existing in the memory (Ausubel, 1977; Faw & Walker, 1976). Learning is meaningful as it is associated systematically with similar concepts of the new information (Ausubel, 1963 and 1968; Ausubel & Robinson, 1969). In other words, the new information is meaningful if it expands, corrects, or details the one in the memory. In the process of creating a meaning, individual variables such as age, past experiences, socio-economic status, and educational background are efficient. Previous background of students is determinative in their finding the learning as meaningful or not. In contrast to reasoning and induction methods used in discovery learning, Ausubel's model supports deduction and reasoning. Firstly general ideas and then specific subjects are taught. In this model, the duty of the teacher is to help students with dividing the information into small pieces and combining the new ideas with the similar ideas in the memory.The studies conducted by Ausubel revealed that the teaching performed by benefiting from the preliminary organizers encourages the learning more than the teaching performed not using the organizers (Ausubel, 1978); but inconsistent results were obtained from other studies (Barnes & Clawson, 1975). In lessons aiming to teach the relationship between the concepts, the organizers are used efficiently (Mayer, 1984). If a teacher compels a simile much, then the students cannot establish the connection between the concepts. The organizers can be efficiently used for making analogies, maps (diagrams) with familiar subjects while teaching the difficult academic subjects (Faw & Waller, 1976; Verdi & Kulhavy, 2002; Driscoll, 2005).

In Interactive Direct Teaching Based on Constructivist Learning (IDTBCL), learning is evaluated as an oriented change or mental process. This approach includes creating the awareness of students related to the current concepts, creating a broad mental space including multiple conceptual parts, providing the adaptation of the new information to the previous knowledge through constant contextual communication, and harmonization. This model is a promoting model for the students to take into account the importance of the concepts as mental elements, to develop not only positive attitudes towards science and learning, but also towards scientific process skills in order to increase the their achievements.

The purpose of the study is to analyze the effect of Interactive Direct Teaching Based on Constructivist Learning (IDTBCL) Model upon student success and attitude.

2. Method

The pre-test & post-test- control group research design, which is a quasi-experimental research design, was used in the study. For this reason, 50 students attending to grade 10 at an Anatolian High School were chosen as the sampling group and were divided into two groups including 25 students as the control group and 25 students as the experimental group, respectively.

The subjects within the scope of the implementation and the sub-titles are given below:

a) Evaporation

-Steam pressure and the factors affecting the steam pressure

-Evaporation rate and the factors affecting the evaporation rate

b) Boiling

-The boiling point and the factors affecting the boiling point

In the control group, the subject of evaporation and boiling was instructed through the traditional method by the same teacher for two weeks. In the experimental group, the subject of evaporation and boiling depending upon the IDTBCL model was instructed for the same period.

A Conceptual Success Test and an Attitude Scale were administrated to both the experimental and the control groups. A multiple-choice conceptual test including 15 items was prepared to cover the determined acquisitions. The whole of the questions in the test were created by the researchers. This test was performed as a pilot study to 50 students studying at grade 10 and the reliability coefficient (Cronbach alpha) was found as .73. Also, a test developed to determine the attitudes of the students towards the IDTBCL was modified as having 23 questions including Likert-type 7 choices and 9 questions in Part A and 13 questions specifying participation of students to the expression in Part B and 1 open-ended question in which students can express their own different ideas. While the question in Part A of the test evaluated the attitudes towards the performed method, the items in Part B was for measuring the awareness of students on IDTBCL principles. Considering the total scores of students from the pre-test and post-test, quantitative analysis of the test data was performed using the SPSS 15.0 package software. After the pre-test administration, the t-test was carried out in order to determine whether there was a statistically significant difference between the experimental and control groups in terms of the concept success. In order to determine whether there was a significant difference between the groups according to the test results, the ANOVA model was used.

3. Result and Discussions

In order to determine the effect of the IDTBCL upon the student success, the ANOVA analysis was performed to measure the results to determine whether there was a significant difference between the experimental and control groups in terms of the conceptual success. The findings from the statistical evaluation of the data obtained from the answers given by the students in the sample group to the multiple choice questions are presented in Table 1.

Table 1. Independent t-test results of pretest

Group	N	Mean	Std. Dev.	t	p
Experimental	25	.4734	.12176	.341	.961
Control	25	.4328	.17251		

There was no significant difference between the pre-test average scores of the experimental and the control groups, $p>0.05$.

The subjects of evaporation and boiling were explained to the control group using the traditional method and to the experimental group using the IDTBCL. After the treatment, the same test was re-performed to both groups. According to post-test results, the experimental group was more successful than the control group. A statistically significant difference was determined between the post-test scores.

When the groups' posttest scores were analyzed, it was noticed that the standard deviation of the experimental group (M_{exp}: 11.72 SD: 1.20) was lower than the standard deviation of the control group (M_{cont}: 8.56 SD: 2.72). This proved that the success of the students in the experimental group was closer to each other and the students in this

group created a group that is closer to homogeneity in terms of the student success. In the control group, an exact homogeneity could not be observed in terms of student success. According to the results, the IDTBCL model increased the interest of each student in the classroom towards the course and provided attendance to lesson, and it was concluded that it was more efficient upon students' learning the subjects..

Table 2. ANCOVA test results of posttest

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	124.855[a]	2	62.428	13.764	.000
Intercept	474.952	1	474.952	104.720	.000
Pretest	.035	1	.035	.008	.930
Groups	122.511	1	122.511	27.012	.000
Error	213.165	47	4.535		
Total	5479.000	50			
Corrected Total	338.020	49			

(R Squared = .369 (Adjusted R Squared = .343)

When the aforementioned data were analyzed, it was determined that the students in the experimental group had 36 and over scores developed a 72% positive attitude towards the IDTBCL model (see Table 3).

Table 3. Descriptive analysis results of attitudes toward Interactive Direct Teaching Based on Constructivist Learning (IDTBCL) model: Section A

Section A: Item no	Definitely disagree		Partly disagree		Disagree		No idea		Agree		Partly agree		Definitely agree	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	2	8	-	-	-	-	4	16	3	12	6	24	10	40
2	8	32	7	28	1	4	6	24	-	-	2	8	1	4
3	-	-	-	-	-	-	6	24	-	-	5	20	13	52
4	3	12	4	16	1	4	6	24	3	12	5	20	3	12
5	2	8	1	4	3	12	6	24	5	20	6	24	1	4
6	1	4	-	-	1	4	1	4	3	12	9	36	10	40
7	10	40	4	16	1	4	5	20	1	4	1	4	3	12
8	3	12	8	32	-	-	9	36	2	8	1	4	2	8
9	8	32	5	20	2	8	8	32	-	-	-	-	2	8

In Section B, the students' perceptions of The Interactive Direct Teaching Based on Constructivist Learning (IDTBCL) model were asked. When the aforementioned data were analyzed, it was determined that the students who agreed upon the expressions included in item 1-12 and the ones who disagreed upon the item-13 expression developed a positive attitude towards the performed method. Those students were determined as developing a 75.6% positive attitude towards the whole performed attitude scale.

Table 4. Descriptive analysis results of attitudes toward Interactive Direct Teaching Based on Constructivist Learning (IDTBCL) model: Section B

Section B	1	2	3	4	5	6	7	8	9	10	11	12	13
f	17	24	21	21	20	22	12	23	21	13	22	19	23
%	68	96	84	84	80	88	48	92	84	52	88	76	92

Moreover, the part in which we required students to mention their positive or negative views on the *Interactive Direct Teaching Based on Constructivist Learning (IDTBCL)* model was answered at 24% rate. The answers given by the students were as:

- This is a very efficient method, the lesson is more joyful, and the students learn new subjects without getting bored.

- This method is a good teaching method that provides students to make interpretation by associating the subject with the events in daily life even not known and also makes the student more active during the lesson.

- I can only say that it is a highly beneficial method; as a matter of fact it is the one that should be.

- Since this method is the student-led, not the teacher, the student is more active.

The above sentences prove that the students developed a positive attitude towards the IDTBCL model.

4. Conclusions

Recently, common use of the teacher-centered teaching has attracted the attention. The traditional approach orients to memorizing, makes the students accustomed to the prepared one, negatively affects the sense of curiosity and causes raising individual who do not question. In fact, the recent conditions necessitate raising people who question the events, reach and use the information. Knowing something is not adequate, it is necessary to practice the knowledge, and make it into an action. The information invigorates and develops through action. It has been accepted that learning occurs more permanently by acting and implementing. In this sense, the students use their minds and experiences when they are active; they become within the act of learning and try to implement what they have learnt. The fundamental purpose is to actualize the permanent learning and make students the leading actor of the act of learning. In fact, it is a known fact that learning is an individual change. We should make learning environments more dynamic, comfortable and interesting. Due to these and such reasons, it can be said that the *Interactive Direct Teaching Based on Constructivist Learning (IDTBCL)* model will be a promising serious solution alternative to the traditional teaching approach depending upon memorizing. It has been revealed through recent studies that teaching models and methods aiming conceptual based learning rather than the traditional method develop scientific process skills more. Those skills are necessary for hypothesizing and scientific research (Lavoie, 1999). On the other hand, it was determined from the findings obtained from performed implementations that the students have had many misconceptions. However, in the experimental group in which the *IDTBCL* model was implemented, these misconceptions were noticed to be overcome according to the post-test results. According to these results, we can say that this model showed a similar effect to the effect of concept maps, conceptual networks and conceptual change texts.

In teaching implementation performed to the control group, the teacher was exactly at the center of the teaching. This was not regarded as odd by the students and the students were observed as being ready to such an implementation in mental and psychomotor senses. However, in implementation appropriate to traditional approach conducted by the teacher; affective satisfaction was determined as being not possible due to the emergence of *a teacher profile explaining, making students take notes, giving samples or making students find samples and a student profile listening, taking notes, finding examples when asked and giving answers*. In the experimental group, the teacher taking place at the center for the nature of current implementations urges students to make mental activities such as thinking, evaluating and constructing. This situation gave rise to a learning environment in which teacher-student activity was provided through an intense interaction and correct orientations was created. This aforementioned harmonization no doubt requires the energy much higher than the one spent by the teacher directing the traditional teaching process for both the preparation and implementation. Orientating the student who tends to be disorganized or free in intellectual and physical sense as an individual in the natural process towards creating an organized cognitive structure requires a cognitively and affectively experienced teacher to transform the complexity into a system. According to this, it should be considered that learning is a fundamental physiologic need and a contrast change for the natural tendencies of an individual. In order to produce a planned and dimensional change like acting and doing sports, the individual needs fundamental nutritional inputs, and cognitive intellectual and energetic inputs to produce concepts and thoughts from information and thoughts in pieces. According to this, learning can be considered as a beneficial work or oriented change produced by the learner. The most clear indicative of the teacher's professionalism and appropriateness of the chosen implementation method (teaching

model and techniques) is the size of the beneficial work and significant change produced against the spent energy (time and teaching activities).

The first and most important step of starting to the lesson is to establish a good communication with the students. In curricula, teaching methods in which students and teachers can be more active should be chosen. Especially, the methods emphasizing the importance of concepts mentally should be preferred. For that reason, some renovations should be carried out in some fields including the family, school and course-books. A broad learning environment should be provided in order to meet the demands of the students. Variety of teaching activities brings with it the understanding of subjects, a good synthesis of subjects and studying in cooperation. Creating multiple learning environment ensures that students reach the information by themselves (Vebrianto & Osman, 2011). After providing this, it is necessary to determine the limitations of the subject and to discuss the lesson with students using various ways such as asking questions, discussion, revision, repetition, induction, and deduction. This involves much mental effort; however, it has been statistically proved through observation that as long as the student is provided to grasp this activity, the method affects the student success more.

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